REMARKS

Claims 12-22 are pending in the application. By this paper, claims 13 and 18 have been amended. Reconsideration and allowance of claims 12-22 are respectfully requested.

Claim objections

Claim 13 stands objected to as containing a typographical error. By this paper, claim 13 has been amended to correct this error. Withdrawal of the objection to claim 13 is respectfully requested.

Claim 18 stands objected to for failing to specifying units for the claimed portion of impurity. The Examiner assumes the proportion to be by weight but requires correction. This objection is respectfully traversed. The claimed 5% impurity proportion is described multiple times in the application, including, for example, at paragraphs [0034] and [0035] of the published application, US patent publication no. US 2006/0005902 A1. It is submitted that forming alloys and other conducting combinations of this sort is well known to those of ordinary skill in the art and that claim 18, as written, is sufficiently clear and definite within the meaning of 35 U.S.C. § 112. Withdrawal of the objection to claim 18 is respectfully required.

Claim rejections

Claims 12 and 15-17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over US patent number 3,585,088 to Schwuttke ("Schwuttke"). Claim 14 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Schwuttke in view of US patent number 5,405,804 to Yabe. Claims 13 and 18-22 stand rejected under 356 U.S.C. § 103(a) as being unpatentable over Schwuttke in view of US patent number 6,242,808 to Shimizu ("Shimizu"). Reconsideration of these rejections in light of the amendments and arguments herein is respectfully requested.

Schwuttke relates to producing single crystals in semiconductor devices. In one embodiment, Schwuttke discloses irradiating portions of a crystalline film with a laser beam pulse "having an intensity sufficient to re-orient the crystal lattice of the film. Preferably, the intensity is adjusted so as not to cause remelting of the film."

The prior art of record including Schwuttke fails to show, describe or suggest all the limitations of independent claim 12 as amended. Claim 12 recites in part,

> producing a locally delimited thermal region in the finely patterned metal-interconnect and moving the locally delimited thermal region in a direction of the interconnect

(emphasis added). The effect of this movement is "the second grain size being enlarged with respect to the first grain size in the direction of the movement" *(emphasis added)*. Support for this amendment may be found, for example, at paragraphs [0029] and [0037] of US Patent publication number US 2006/0005902 A1.

The Office Action acknowledges that Schwuttke fails to disclose moving the laser beam over the interconnect but asserts that this type of movement would be obvious, especially since in one example, Schwuttke's laser beam covers an area smaller than a test stripe. The office action asserts that "one would be motivated to recrystallize the entire area because larger grains enhance the performance of electronic devices." Movement of the laser beam must be inferred from a result which is not disclosed in Schwuttke.

Even if the asserted motivation is true and movement may be inferred from Schwuttke's statements, there is no suggestion in Schwuttke to move the laser *in the direction of the interconnect* as recited in claim 12. As noted, there is no explicit teaching of moving the laser in Schwuttke. Movement is inferred only. In Schwuttke's Example IV, reference is made to irradiating the film "a number of times at different locations and at different energy levels." Column 6, lines 65-67. This recitation, though, fails to suggest any pattern or non-random movement of the laser. In particular, there is no suggestion to move the laser in the direction of the interconnect. This is a unique feature of claim 12 missing from Schwuttke.

Moreover, this missing feature provides an important advantage which is not realized by Schwuttke or any of the prior art of record. Paragraph [029] of the present application explains,

> After such a realization of very narrow (e.g. less than 0.1 micrometer) dual damascene Cu interconnects 5, a fanned-out laser beam, for example, for producing a locally delimited thermal region W sweeps slowly along a primary direction x of the interconnects or metal-containing layers 5 and heats the latter to a local temperature within a range of from approximately 150 degrees Celsius to 450 degrees Celsius. The movement (e.g. 1 cm/second) of the temperature front thus produced along the interconnect 5 enables a recrystallization of the small and

> randomly distributed copper grains from a first grain size 5A to an enlarged second grain size 5C. **More precisely, a tendency towards the production of grains that are lengthened in the direction of movement or in the direction of the interconnects 5 results in this case.**

(emphasis added). Thus, not only does the claimed method produce larger grain sizes, those grain sizes are enlarged in the direction of movement. This increases electrical conductivity and improves electromigration properties, in a way which is not suggested by Schwuttke.

Still further, the phenomenon relied on to produce these unique effects is distinct from the operation of Schwuttke. Claim 12 recites producing a locally delimited **thermal** region. This thermal region is then moved in relation to the interconnect. Thermal energy or heat is the operative physical property for producing the unique result. In clear contrast, Schwuttke specifically disavows heat or any process that would cause melting or vaporization of the interconnect film. Schwuttke column 2, lines 56-56 states "Preferably the intensity is adjusted so as not to cause remelting of the film." Column 4, lines 43-45 states, "If the energy of the beam is too high the film 10 will be melted or in more extreme cases evaporated. This is undesirable." In Schwuttke's Example 5 from the bottom of column 5 to the top of column 6, after irradiation, "It was noted that a local melting and evaporation of the film occurred in the irradiated area" and "It was concluded that the relatively thin film did not provide sufficient dissipation of the heat at the level of irradiation." Instead of heat or a thermal region, Schwuttke asserts that in his device, "energy is dissipated as a shock wave which causes an instant recrystallization of the film in the region being bombarded." Column 4, lines 30-34.

Thus, whereas claim 12 recites a thermal region for producing the change in grain size, Schwuttke specifically disavows use of thermal energy. As was made clear above, claim 12 includes limitations—a locally delimited thermal region—not shown in Schwuttke and specifically rejected there. Dependent claim 16 goes further and recites production of the thermal region by sources such as a fanned-out laser beam, a hot gas, a multiplicity of heating lamps and/or a heating wire. These claimed improvements are clearly not shown or suggested by Schwuttke.

A rejection under 35 U.S. § 103(a) may only be maintained if all elements of a claim are taught or suggested by a reference or combination of references. MPEP § 2143. In the present application, as noted above, Schwuttke and the other prior art of record, even taken in

combination as proposed in the Office Action, fails to disclose all of the limitations of claim 12. Claims 13-22 are dependent from claim 12 and add further limitations thereto. These claims are allowable for the same reasons. Accordingly, withdrawal of the rejections of claim 12-22 is respectfully requested.

With this response, the application is believed to be in condition for allowance. Should the examiner deem a telephone conference to be of assistance in advancing the application to allowance, the examiner is invited to call the undersigned attorney at the telephone number below.

Respectfully submitted,

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July 7, 2008
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